Evaluation of a Medication Management Program for Older Adults

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Abstract

Background: As the prevalence of chronic disease increases among older adults in the United States, the need for medical interventions to adequately manage disease is also growing. Increased prescription drug use and care by multiple health providers among older adults are associated with potentially inappropriate prescribing, which may lead to adverse drug events. The HomeMeds Medication Assurance Program (HomeMeds program) is an in-home medication risk assessment for older adults to identify and prevent potentially inappropriate prescribing.

Objective: To determine the effectiveness of the HomeMeds program by describing the attitudes about the program among the target population, identifying barriers and facilitators to the program, and evaluating the results of medication risk assessments.

Methods: Qualitative data were collected through focus group sessions with members of the target population and key informant interviews with HomeMeds program staff and experts in geriatric clinical pharmacy. Quantitative data were collected using the HomeMeds program database.

Results: Barriers to participation in the program were a lack of awareness about the susceptibility and severity of potentially inappropriate prescribing among older adults, trust in the health care system to accurately track medications, and fear of breach in confidentiality. Clients who took five or more medications were more likely to have an alert generated in the HomeMeds system than clients who took fewer medications. Despite this, less than 35% of alerts resulted in follow-up consultations between the partnering pharmacist and client. HomeMeds staff experienced

challenges with recruiting individuals and providing clinically relevant recommendations about medications.

Conclusion: The public health significance of this study is that community programs that implement medication risk assessments may not be effective in preventing potentially inappropriate prescribing in older adults. Improvements to the HomeMeds program should include pharmacist-led educational sessions to provide the information necessary to motivate participation in the program. Program champions at AgeWell residential sites should be leveraged to identify vulnerable older adults and facilitate participation. Finally, partnerships with local primary care practices should be formed to recruit clients to the program, provide comprehensive information about clients' health history, and evaluate outcomes that result from participation.

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Preface

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1.0 Introduction

The HomeMeds Medication Assurance Program is an evidence-based program to prevent potentially inappropriate prescribing in older adults. Issues related to potentially inappropriate prescribing, which may lead to medication errors, are often associated with aging. To combat this, the HomeMeds program provides an in-home review of clients' prescription and non-prescription drugs. Medications are entered into the HomeMeds database and assessed by a pharmacist. Follow-up consultations between the client and pharmacist are conducted to ensure appropriate medication management. If therapeutic duplications or harmful drug interactions are indicated, the pharmacist will provide recommendations for remediation. Pharmacists may also contact the client's prescriber with their findings. The main purpose of the HomeMeds program is to identify and alert older adults and their healthcare providers to possible risks associated with their medications through a systematic, comprehensive review of their prescription and non-prescription drugs.

AgeWell Pittsburgh began the HomeMeds Medication Assurance Program in 2015. AgeWell Pittsburgh is an organization that provides resources for older adults and their caregivers to help them address issues associated with aging. AgeWell is a collaboration between three local agencies within Pittsburgh, PA: the Jewish Community Center of Greater Pittsburgh, the Jewish Family & Community Services, and the Jewish Association on Aging. Operating through each of these agencies, AgeWell supports over 10,000 clients and caregivers. Outreach occurs throughout the greater Pittsburgh area in community centers, low-income housing units, and senior living facilities. AgeWell Pittsburgh is sustained through funding provided by the United Way of Southwestern Pennsylvania, the Jewish Healthcare Foundation, the Allegheny County Department of Human Services, and the Jewish Federation of Greater Pittsburgh. The mission of AgeWell is

to implement community-based programs that allow seniors to live independently in their home. AgeWell services include transportation, food and nutrition programs, caregiver resources, bereavement support groups, counseling, and care coordination. Included in the services provided by AgeWell Pittsburgh is the HomeMeds program, a medication management program for older adults.

Given the large population of older adults in Southwestern Pennsylvania and clients who use AgeWell services, this program is a vital tool for driving the AgeWell mission to keep older adults safely at home. However, the program has consistently experienced challenges with recruiting participants. Because the program does not implement regular evaluation, further research is needed to determine the feasibility and acceptability of the program and inform future operations of HomeMeds. In this study, I will use mixed methods to analyze the effectiveness of the HomeMeds program and provide recommendations to help address barriers and broaden the reach of its services. My specific aims are:

Specific Aim 1: To evaluate the prevalence of risks associated with polypharmacy among participants in the HomeMeds program.

Hypothesis 1: HomeMeds program clients who are prescribed five or more medications are more likely to have a medication alert generated by the HomeMeds database than clients who take fewer medications.

Specific Aim 2: To describe the attitudes and perspectives about the HomeMeds program among the target population and HomeMeds staff.

Hypothesis 2: Members of the target population are reluctant to participate in the program due to a lack of trust in the HomeMeds staff and minimal knowledge about potentially inappropriate prescribing in the health care system.

2.0 Background

2.1 Aging, Chronic Disease, and Health Care Utilization

In 1900, life expectancy in the United States was 47.3 years of age[1]. The most common cause of death was infectious disease [2]. Today, despite a recent decline from the effects of opioid-related deaths and the emerging impact of the coronavirus pandemic, life expectancy is now 78.7 years[3]. Accompanied by a decreasing birth rate, the country faces an aging population[2]. By 2030, over 20% of the United States population will be adults over the age of 65 years[4, 5]. Because health care has shifted and the ability to manage infectious disease has improved, chronic disease has emerged as the leading cause of death in the United States[3, 6]. A chronic disease is an ongoing, usually incurable illness that requires continuing medical intervention and may interfere with activities of daily living[6, 7]. Over 50% of the U.S. population suffers from a chronic disease[6, 8]. This is especially common among older adults, 80% of whom suffer from at least one chronic condition[9]. For instance, more than 22% of adults over the age of 65 suffer from diabetes and almost 60% of Medicare beneficiaries over the age of 65 have been diagnosed with hypertension[10]. Moreover, older adults are also more likely to suffer from multiple comorbidities. Approximately 77% of older adults suffer from two or more chronic diseases[9].

The strain of managing multiple chronic conditions creates both personal and health system-wide challenges[6]. As the prevalence of chronic disease increases in the United States, the need for medical interventions to adequately manage disease is also growing. Approximately 75% of annual health care expenditures in the U.S. are used to treat chronic diseases[9]. Given the state of the nation’s aging population and the corresponding increase in chronic disease, this

burden on the health care system is likely to intensify[6]. Overall, patients with multiple chronic diseases require more health care services, such as emergency department stays, inpatient and outpatient visits, and prescription drugs[8]. This results in increased health care expenditures, where individuals with five or more chronic diseases spend 14 times more on health care services than individuals with no chronic conditions. On average, these individuals also use twice as many drugs each year than individuals with only three or four chronic diseases[8]. Not surprisingly, increasing reliance on prescription drugs to manage disease has had an impact on the population of older adults with chronic conditions. Subsequently, as the prevalence of chronic disease in individuals over the age of 65 increases, polypharmacy, or the simultaneous use of five or more medications, has become more prevalent among older adults[11, 12]. In 2010, nearly 40% of adults over the age of 65 were taking five or more medications[13]. While the use of prescription drugs is a vital aspect of health maintenance, polypharmacy can also lead to unintended, negative health outcomes.

2.2 Polypharmacy and Adverse Drug Events

Among the complications associated with polypharmacy is an increased risk of drug duplication, harmful drug interactions, and medication errors that lead to adverse drug events[14-17]. An adverse drug event is an unintended, harmful event caused by a drug. This may manifest in any of the body's systems, including the central nervous system, gastrointestinal system, and dermatologic system[18]. The outcomes of an adverse drug event can range from undetected to fatal. For example, common signs and symptoms associated with an adverse drug event include dizziness, cognitive impairment, or unintentional overdose[16, 18, 19]. Evidence suggests that the

risk for adverse drug events increases significantly with the number of drugs consumed[18, 20]. Along with the harmful health outcomes that may result from an adverse drug event, it is also associated with increased health care utilization. Adverse drug events account for almost 300,000 hospital admissions each year and are estimated to result in over $5 million in health care costs[12]. In addition to the risks that older adults are exposed to through polypharmacy, aging-related physiologic changes, such as altered metabolism, decline in renal function, and decreased body mass, may make them more susceptible to adverse drug events[16, 21]. Subsequently, adverse drug events are a leading cause of emergency department visits by older adults[22].

Another consequence of adverse drug events that can be caused by polypharmacy are increased frequency of falls[23-25]. The World Health Organization defines a fall as "an event which results in a person coming to rest inadvertently on the ground or floor or other lower level"[26]. Although physiologic changes that accompany aging may explain the incidence of falls in older adults, the cumulative effects of chronic disease and the drugs needed to treat them also contribute to this risk[27]. Approximately one in three people over the age of 65 fall each year[28]. Falls account for the leading cause of fatal and nonfatal injuries, such as fractures and traumatic brain injuries, in older adults[9, 27]. They are also the seventh most common cause of death in people over the age of 65 [9, 28, 29]. In addition, injuries related to falls may result in multiple complications that interfere with an individual's capacity to perform activities of daily living. Similar to other outcomes associated with adverse drug events, falls result in increased health care utilization. Hence, approximately $50 billion are spent on the treatment of fatal and non-fatal falls in the United States each year[27].

2.3 Factors Contributing to Polypharmacy and Medication Errors

There are many factors that contribute to polypharmacy and medication errors in the U.S. One of the most common factors is the challenge of navigating a complex healthcare system with chronic disease. As an individual's comorbidities increase, they also experience a greater need for care by multiple medical providers. Evidence suggests that the number of healthcare providers treating a patient is an independent risk factor for adverse drug events[30, 31]. This may be caused by polypharmacy or medication errors that result from potentially inappropriate prescribing. An estimated 50% of adverse drug events are caused by errors when prescribing or dispensing a drug[18]. Potentially inappropriate prescribing increases after a hospital admission and often occurs during transitions of care[21, 32]. Possible explanations for potentially inappropriate prescribing are a lack of communication between multiple healthcare providers and failure to correct resulting medication errors. Additionally, the cascade effect, or use of a medication to treat a side effect caused by a different medication, may further exacerbate this situation[33]. Consequently, individuals who require multiple medical interventions are also at an increased risk for potentially inappropriate prescribing. Given that older adults have more comorbidities, may be treated by multiple providers, and require complex drug regimens, they are therefore more likely to experience adverse drug events that are caused by potentially inappropriate prescribing[12, 15].

In addition to factors in the health care system, another issue that may contribute to adverse drug events are inappropriate drug administration. Approximately 30% of adverse drug events are caused by incorrect administration of a medication[18]. This error could occur with any variable in the administration process (*e.g.* type of medication administered, dose, time, etc.). While human error will always be a factor in inappropriate medication administration, low health literacy is also likely to magnify this issue. The Office of Disease Prevention and Health Promotion defines health

literacy as “the ability to obtain, process, and understand basic health information and services to make appropriate health decisions[34].” Only 21% of adults in the United States have a basic health literacy level and 14% have a below basic health literacy level[34]. Evidence suggests that low health literacy is attributed to low medication adherence and increased hospital readmission rates[35-38]. For older adults who have complex drug regimens, health literacy can be a crucial factor in their ability to appropriately manage their medications. For example, in a longitudinal study of older adults with complicated drug routines, individuals with low health literacy were more likely to make a medication error[38]. It is estimated that only 3% of adults over the age of 65 have a proficient health literacy[39]. As a result, health literacy in older adults may be a factor contributing to the complications with medication management and prevalence of adverse drug events in this population.

2.4 Needs Assessment for Older Adults in Pittsburgh

Approximately 18.9% of Allegheny County’s population is over the age of 65, more than 3% above the current national average[40]. With a growing older population, the county faces an important challenge to assist and care for individuals who may have multiple comorbidities, higher health care burdens, and a declining ability to maintain their basic needs. Moreover, data suggest that the population of older adults in Allegheny County experience the same risks associated with aging that are seen in national trends. In 2018, over 5,000 Allegheny County residents above the age of 65 were hospitalized from a fall. This age-group accounted for more than 73% of all fall-related hospitalizations[41]. In the same year, falls were also the most common mechanism for an injury-related hospitalization and cost over $550 million in total medical costs. Additionally, 10%

of Allegheny County residents are functionally illiterate [42]. There is no data regarding the health literacy of Allegheny County residents. However, following national projections of health literacy for people over the age of 65, this could be a significant problem for older adults in Allegheny County and create barriers to proper medication management. Considering these factors, it is likely that older adults in Allegheny County also experience the risks associated with potentially inappropriate prescribing and adverse drug events. Given the rate at which Allegheny County's population is aging, the services provided by the HomeMeds Medication Assurance Program could help at-risk older adults maintain their independence and remain living safely at home. Furthermore, the HomeMeds program could help to address the personal and system-wide burdens associated with potentially inappropriate prescribing by decreasing adverse drug events and health care expenditures for older adults in Allegheny County.

2.5 Partners in Care HomeMeds Program

HomeMeds is an evidence-based program developed by the Partners in Care Foundation to review clients' medications and identify potentially inappropriate prescribing that could lead to adverse drug events. The intervention aims to address potentially inappropriate prescribing commonly caused by lapses in communication and care coordination between clinicians[32]. Given that older adults represent nearly 40% of patients affected by medication errors, the program focuses on individuals who are over the age of 65[43]. Approximately 48% of community-dwelling older adults take potentially inappropriate medications (*i.e.* drugs identified as inappropriate in all circumstances regardless of disease or dosage)[44]. Subsequently, the HomeMeds program also focuses specifically on older adults who are community-dwelling.

Similar to AgeWell Pittsburgh, the Partners in Care Foundation uses community-based care services to improve the health and self-efficacy of individuals with chronic disease. As a result, the HomeMeds program was developed to reduce hospitalizations and readmissions, monitor drug adherence, and prevent medication-related adverse events in community-dwelling older adults. The overarching goal of this program is to identify and alert individuals and their clinicians about the potential risks associated with a client's medications that may cause an adverse drug event.

The HomeMeds intervention (*see Figure 1)* is based on existing literature that pharmacists play a key role in the medication management of older adults[32, 45, 46]. However, a pharmacist is often an underutilized resource in the care of patients with multiple comorbidities who receive treatment from numerous medical providers[47]. Research has found that similar interventions, which implement a pharmacist-led review of patients' prescription and non-prescription drugs, helped to improve care coordination for older adults and systematically monitor their medications[46-52]. Medication management interventions have led to increased patient self-advocacy, independence, and medication adherence[49, 51]. Additionally, program outcomes

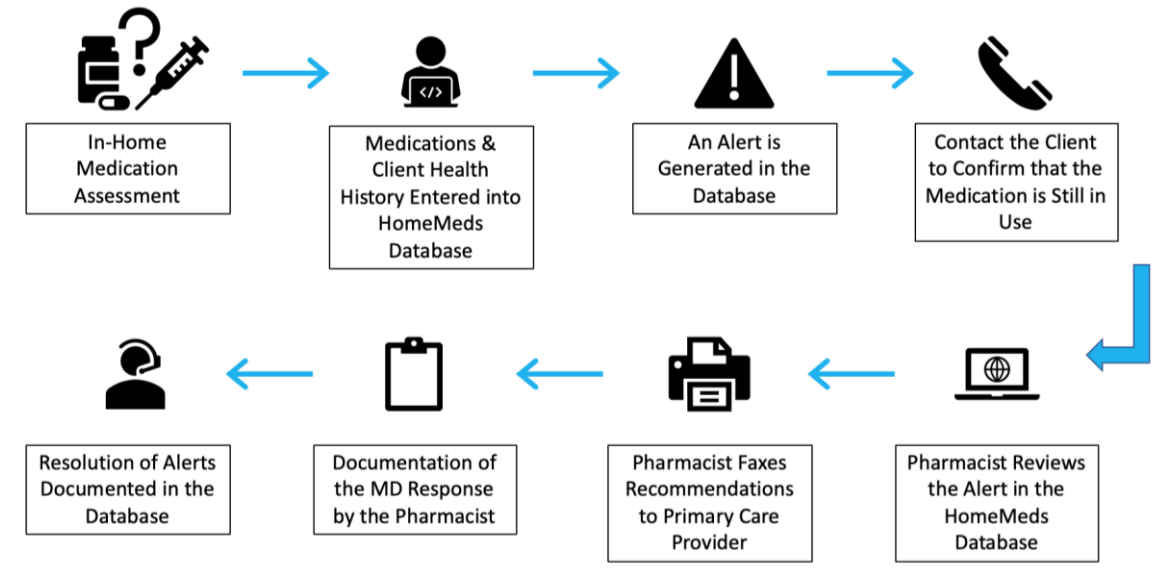

Figure 1. HomeMeds Intervention Process

often included a reduction in the client's dosage and monthly prescription drug costs[47, 50, 51]. Thus, through this program, the Partners in Care Foundation aims to promote patient self-efficacy, independence, and safety.

Developed in 2011, the HomeMeds Medication Safety Program uses an online software database to implement a computerized medication risk assessment screening and alert process for possible adverse drug events. The HomeMeds program is a joint operation between community-based organizations that coordinate the review of the client's medications and contracted pharmacists who interpret the medication risk assessment results. Since its inception, the program has served over 10,000 older adults, nearly 50% of whom had a risk associated with their medications[14]. HomeMeds has been implemented in 18 states in the U.S. and is an approved Disease Prevention and Health Promotion program[14]. It has received a strong evidence rating on the U.S. Agency for Healthcare Research and Quality Innovation Exchange and was awarded the Highest Evidence Level rating by the U.S. Administration for Community Living. The Partners in Care Foundation also operates a more recently developed HomeMeds *Plus* Program. This is a three-step intervention to reduce emergency department and hospital readmissions for at-risk older adults. Along with a medication risk assessment HomeMeds *Plus* features a psychosocial and environmental risk assessment and the development of an individualized service plan for clients. Service plans include the creation of a risk assessment follow-up strategy, based on the client's needs, with family caregivers or care coordinators[14].

2.6 AgeWell Pittsburgh HomeMeds Program

Similar to the Partners in Care Foundation, AgeWell Pittsburgh serves as the community-based organization that funds and implements the HomeMeds program. Given the three-pronged approach to the provision of AgeWell services, the HomeMeds staff who coordinate the program are either a senior center staff person (Jewish Community Center), nurse navigator (Jewish Association on Aging), or social worker (Jewish Family & Community Services). The medication review can take place in the client's home or at the coordinating agency. This intervention begins with informed consent provided by the client. Then, the HomeMeds staff member records the basic demographic information and self-reported medical history of the client. Depending on the location of the visit, medication information is collected using a medication information form or entered directly into the online HomeMeds database. During each visit, the client's blood pressure and pulse are recorded using a digital wrist blood pressure monitor. Each of these categories of data (*see Table 1.*) are added to the client's profile in the HomeMeds database.

Table 1. HomeMeds Program: Collected and Recorded Medication Information

Variable	Example
Name of Medication	Brand or generic name
Dosage or Strength	10mg
Amount/form	1 tablet; ½ teaspoon
Frequency	Every 4 hours, or 3 per day
Route	Oral
Prescribing Physician	Name & Phone Number
Dispensing Pharmacy	Name & Phone Number

Giant Eagle Pharmacy is contracted by AgeWell Pittsburgh to provide the clinical expertise needed for the interpretation of the online medication risk assessment results. Each week, the Giant Eagle pharmacy team is sent a report with new clients' medication assessments. Reports include each client's basic information (*i.e.* name, date of assessment, and assessment site). The pharmacy

team will then review all new clients in the HomeMeds database. If no alert is generated in the database, they will mail a report documenting this information to the client. If an alert is generated, the pharmacist will review the alert to determine if it is clinically-significant. If the pharmacist determines that the alert is legitimate, they will call and consult with the client to provide education and recommendations. The client may provide permission for the pharmacist to contact their prescribing physician with their results and recommendations. Barring medical emergencies, contact by the pharmacist to the prescribing physician is only made if permission is given by the client. If a client cannot be reached by telephone, the pharmacist will send a letter to the client's home requesting that they call the pharmacy for the results of their medication risk assessment. Once the pharmacist has spoken with the client over the phone, they will send a final report with their findings to their home. The AgeWell HomeMeds program does not include documentation of whether medication changes were made by the prescribing physician. Additionally, clients are not followed after participating in the program to track possible adverse drug events, overall health care utilization, or other outcomes that result from the medication risk assessment.

3.0 Methods

3.1 Qualitative Data Collection and Analysis

Qualitative data in this study were collected through focus group sessions and key informant interviews conducted in December 2019 and January 2020. Focus group sessions were held with members of the HomeMeds program target population—individuals who are 65 years and older and live in the greater-Pittsburgh area. The focus group sessions were conducted at the Jewish Community Center and New Riverview Apartments, which are sites associated with AgeWell Pittsburgh. The sessions were conducted with two key groups of the target population: members of the Jewish Community Center who have previously participated in the program and residents of the New Riverview Apartments who have not participated in the HomeMeds program. Previous participants were chosen to provide their perspectives on the benefits of participation, experience with using the program, and knowledge about potentially inappropriate prescribing. Individuals who had not participated in the program were included in a separate session to understand possible barriers to participation, the perceived utility of the program in meeting their medication needs, and overall knowledge about potentially inappropriate prescribing. Focus groups were chosen as the method for qualitative data collection to allow for the exchange of ideas and iterative response to questions through group discussions and dynamics. Additionally, focus group sessions were chosen instead of other qualitative research methods to identify the attitudes and reactions about the HomeMeds program through group interactions[53].

Participants were selected through purposive sampling by a HomeMeds staff member (Jewish Community Center) and service coordinator (New Riverview Apartments). To recruit

individuals who had participated in the HomeMeds Program, a list of previous clients who may be interested in providing feedback through a focus group session was created by a HomeMeds staff member. Individuals from this list were contacted by telephone to explain the purpose of the focus group session and request participation. Two follow-up calls were placed to interested participants to confirm the focus group date and time and remind them of the upcoming session. Participants for the focus group session that was conducted with New Riverview residents were recruited by the New Riverview service coordinator. Individuals who had not participated in the HomeMeds program were specifically selected for this focus group session.

Focus groups ran one-hour in length and were conducted in conference rooms located at each of the sites: the Jewish Community Center in Squirrel Hill and the New Riverview Towers Apartments located in Squirrel Hill South. The sessions were recorded using VoiceMemo software on a laptop computer. Verbal consent was provided by each of the focus group participants before beginning the session. Questions related to four pre-determined themes: knowledge about potentially inappropriate prescribing, issues related to medication management, barriers to HomeMeds, and facilitators to HomeMeds; were used to format the focus group session. Pre-determined themes were developed from preliminary discussions with HomeMeds leadership about challenges with recruitment for the program and background literature on polypharmacy and adverse drug events. Questions related to these themes were formatted to evaluate the feasibility and acceptability of the program among the target population. Given the differing familiarity with the HomeMeds program between the groups, session guides were tailored to the type of respondent (*see Table 2*).

Focus group sessions were recorded and descriptive notes were taken throughout. Focus group recordings were transcribed for data analysis. Responses were read through and commonly

repeated themes were noted. Unique perspectives that were reported during the sessions and relevant to the feasibility and acceptability of the HomeMeds program were also noted. These minority points of view were included in the data analyses to enhance the credibility of the qualitative findings[53]. Predetermined themes that were developed from discussions with HomeMeds leadership and existing literature were modified to incorporate new findings from participants. Additional codes were also developed to describe unexpected findings that emerged from the data. After review of the data, a codebook with a defined set of codes was developed and used for data analysis. Codes were tracked for frequency in each of the focus group session transcripts. Representative quotes were selected for succinctly describing key themes expressed during the session by a range of participants.

Table 2. HomeMeds Focus Group Sessions: Question Examples

Previous HomeMeds Participants	Potential HomeMeds Participants
What were your initial thoughts when you heard about the HomeMeds Program?	Do you ever worry about medication problems?
What made you decide to participate?	Have you ever thought about how your medications might interact with one another?
What did you find most useful about the HomeMeds Program?	How would you deal with a problem with your medications?
What were your initial thoughts after participating in HomeMeds?	Have you ever heard about the HomeMeds Program?
Is HomeMeds something you would participate in again?	What are your initial thoughts about a program like this?
When you think about the medications you take, are you ever worried about medication problems?	Is HomeMeds something you would participate in?
If you were inviting a friend to participate in HomeMeds, what would you tell them?	Who would you trust to learn about a program like HomeMeds?
If you were running the HomeMeds Program, what would you do differently?	What do you think would make HomeMeds a better program?

Other qualitative data for this project were collected using key informant interviews with HomeMeds personnel and a geriatric clinical pharmacist. Interviews were conducted over the phone or in-person using a semi-structured interview guide. Questions focused on the overall

intervention process, issues related to recruitment, and challenges experienced by HomeMeds staff. Two HomeMeds personnel were interviewed: a Giant Eagle pharmacist and a nurse navigator from the Jewish Association on Aging. Additionally, an interview with a geriatric clinical pharmacist from the UPMC Benedum Geriatric Center was conducted. Interviews were requested with these individuals due to their key roles in the operation of the HomeMeds program or knowledge about medication management in older adults. Interviews were selected as a method of qualitative data collection to accommodate the schedules of key informants and to capture empirical data that were specific to their role and experience [53]. One interview was recorded using VoiceMemo on a laptop computer and transcribed verbatim. Verbal consent was provided by the participant before proceeding with the interview. Due to technical limitations, the remaining interviews were not audio recorded, but were documented using descriptive notes.

Questions for key informant interviews related to five pre-determined themes: client population and needs, barriers to HomeMeds, facilitators to HomeMeds, the intervention process, and opportunities for improvement (*see Table 3*). These themes were developed based on background literature about pharmacist-led medication management programs for older adults and preliminary discussions with HomeMeds leadership about the program. Because the key informants were involved in different aspects of the HomeMeds program, additional questions that related to their specific role in the intervention process were included in each interview. The interview conducted with a geriatric clinical pharmacist at the Benedum Geriatric Center related to broader issues of medication management among older adults, barriers to navigating the health care system, and the perceived utility of the HomeMeds program in addressing the needs of the target population. The key informant interview transcript and descriptive notes were reviewed and commonly repeated themes were documented. Unique perspectives that were reported during the

interviews and relevant to the feasibility and acceptability of the program were also noted. To enhance the credibility of the qualitative findings, pre-determined themes were adapted to accurately describe the data[53]. Additional themes that were not pre-determined were developed based on findings that emerged from the interviews. These were included to provide more in-depth perspective about the program among the HomeMeds staff and experts in geriatric clinical pharmacy. A defined codebook was developed from this information and used to analyze the data by theme. Codes were tracked for frequency in the key informant interview transcript and descriptive interview notes. Representative quotes of themes expressed during the key informant interviews were selected and presented in the study findings.

Table 3. HomeMeds Key Informant Interviews: Sample Questions

Sample Question	Theme
What types of health issues do your clients most often deal with?	Client Population & Needs
What issues do you most often experience in trying to implement the HomeMeds program?	Barriers to HomeMeds
What do you think make the HomeMeds program successful?	Facilitators to HomeMeds
What do you think would be most helpful to change about the HomeMeds program?	Opportunities for Improvement

3.2 Quantitative Data Collection and Analysis

The HomeMeds software database is an essential tool for the operation of the HomeMeds program. The database serves as the platform to store client data and conduct medication risk assessments. As a result, quantitative data for this project were collected using the HomeMeds software database. Collected variables included participant demographics, frequency of medication alerts, client health history and intervention activities. Quantitative data from 1,045

HomeMeds participants were analyzed for this project. Chi-square tests were conducted to determine whether participants with five or more prescriptions were more likely to have an alert generated in the database than those with fewer prescriptions. The data were used to determine the overall risks associated with polypharmacy among individuals who choose to participate. Additionally, bivariate descriptive statistics were performed to determine the relationship between generated medication alerts among participants and follow-up consultations with pharmacists. This information was used to determine whether the perceived risks of medications were significant enough to warrant further intervention by the Giant Eagle pharmacy team. All of this information was used to understand the overall benefit of the program to the participants. This study was a part of a quality improvement project for AgeWell Pittsburgh and was deemed exempt from IRB review.

4.0 Findings

4.1 Qualitative Findings

4.1.1 Focus Group Session: Jewish Community Center Members

The focus group session conducted with previous HomeMeds participants was held in a bright conference room across from the AgeWell offices located at the Jewish Community Center in Squirrel Hill. The session took place on a Friday at 1pm. A total of five participants joined the session. Two individuals were unable to participate for the entirety of the session and, therefore, left early. Four of the participants were female and one participant was male. Three of the five participants were African American. Two participants were Caucasian. Three of the participants traveled to the session using the Access Transportation system, which provides transportation services to senior citizens and individuals with disabilities. All attendees reported regular use of the AgeWell services provided at the Jewish Community Center and had participated in the HomeMeds program at least one time before the focus group session. Coded variables and the frequency in which they were communicated during the focus group session at the Jewish Community Center are included in *Table 4.* Details on the themes for the focus group sessions are included in the *Appendix. Qualitative Data Codebooks.*

Table 4. Focus Group Sessions: Themed Response Frequency

Theme	Jewish Community Center	New Riverview Apartments
Program Benefits	11	8
Privacy	2	7
Health Care Self-Efficacy	4	2
Medication Management Challenges	4	3

Table 4 Continued

Negative Health Care Experience	4	1
Medication Knowledge & Beliefs	8	5
Trust in Health Care Providers	5	10
Utilization of Pharmacy Resources	7	4
Operational Improvements	3	2

Representative quotes were selected to illustrate themes that were expressed during the session. Overall, participants reported that they experienced **medication management challenges**. Even with routines in place to organize and prepare their prescriptions, such as maintaining a list of all their medications or setting out their pills at the beginning of each week, they did not feel confident in their management skills. For example, one participant reported:

> *"I make up every week, once a week, I put my meds together for one week. And yet, I have not been able to do it perfectly. I'm either missing one or one is somewhere else. I'm just wondering as I age, I'm gonna need somebody to help me do that."*

Another focus group participant stated:

> *"I do the same thing and then I forget to put maybe one pill in that slot that I'm supposed to take that day. And, so, and then there's three you take in the evening."*

Consequently, the perceived **benefits of the program** were the most frequently communicated theme during the session. For example, participants reported that the program served as an additional measure to ensure safe prescribing and medication routines. One woman stated:

"I thought this program might be a way to get a third-party who has no preconception about me to look at my medications and get back to me. And also, I would be more likely to share over-the-counter medications that I'm taking in, with the interview process that HomeMeds has."

An additional member reported:

"You know, the more help, the more, the merrier, the different things you go to. . . You know, so I think a lot of the programs, you know, they can offer you things that can help you out at home, and make life easier, you know."

A commonly reported theme related to the participants' **knowledge and beliefs about medications**. Their comments diverged into two different categories: current knowledge of medications and improved knowledge about medications that resulted directly from participation in the HomeMeds program. For responses that related to current knowledge about medications, participants communicated an understanding that medications affect individuals uniquely, can interact with one another negatively, and may respond differently if a person's diet or physiological characteristics change. Improved knowledge about medications that resulted from participation in the program related to their understanding of possible medication prescribing errors that are made by providers and common in the health care system. For example, one participant stated:

"I question when I received new medication. Where before I would just accept it, you know, as a doctor, you know, knows what he's doing or saying, whatever. But I question why they're changing medication for that reason."

This also contributed to enhancing particpants' **health care self-efficacy**, as explained by one individual:

"When they called me with the results, they really didn't tell me anything I didn't know on some level. But they put it together in a nice way that I hadn't thought of. And that, um, encouraged me to talk to my doctor about, um, this is a potential problem. I don't have it right now, but how do I tell if I'm getting it? . . . And that's something I'll do in the future now with anything."

These findings lead to another frequently coded response: **trust in health care providers**. Many of the participants reported general mistrust in their prescribing doctors that resulted from communication issues and differences between the doctors' opinion and the participants' personal experience and knowledge about their health. For example, one attendee stated:

"The doctors are doctors. They forget that we're human beings with brains, I think. Some of the time they take a look at us and they say 'Ugh, here's your medicine. Take it. It has a few side effects.' They don't have the time to explain what I'm looking for."

Other participants stated their worries about whether health care providers were communicating with one another and if clinicians had a full understanding of the treatments they were receiving in all aspects of their health care. Another participant commented:

"[the doctor] really doesn't take that much time, and they don't find out, really, what you're taking or not taking. And, you can't, even if you call them, you don't even talk to your doctors. You go through other people, two and three people, and they call you in what? —24-hours, 48-hours or whatever."

Participants did comment on their **utilization of pharmacy resources**. One participant described that "*people really have to be educated about the pharmacist, that they're their friends."* The

group agreed that a pharmacist was a key resource for navigating a complex health care system with multiple providers. They stressed that utilizing pharmacy resources for education about prescription drugs was a vital aspect of health care maintenance and promoted their health care self-efficacy. For example, a particpant explained:

> *"And my pharmacist is a big help. He looks in the computer and looks for trial offers to see if I can get cheaper medications. So, your pharmacist can be helpful with your financial, too."*

Additionally, they felt that as a result of the program, they are better equipped to question their doctors' recommendations, initiate conversations with their pharmacists about their medications, and request information on the signs and symptoms of an adverse drug event.

In general, the only barrier reported about participation in the HomeMeds program was the potential for a breach of confidentiality that one participant reported. She expressed her initial concerns with the privacy of her health care information when first approached about participating in the HomeMeds program. She stated:

"My initial thought was, that's asking for an awful lot of information. And, who's getting this information? And, is it really worth it? Isn't this something I can do myself by going to my pharmacist?"

She added:

"*But, I'm giving the information to a third-party. And, although we were all told that it's confidential, um, like you wonder who is getting the information. Is it just the pharmacist?"*

However, despite her apprehension, her relationship with the AgeWell Pittsburgh staff and knowledge from previous experiences with other programs convinced her to proceed with participation. Overall recommendations for the program from the Jewish Community Center focus

group related to **operational improvements**. For example, attendees suggested that increasing and enhancing the quality of advertisements could help with recruiting individuals for the program. Additionally, the group felt that providing monetary incentives for participants was important and may be a deciding factor in some individuals' decision to take part in the program. Finally, one attendee thought it would be helpful to include specific education about the harms of potentially inappropriate prescribing during the HomeMeds visit. Furthermore, HomeMeds participants should be provided with tips on talking about their medications, so they have the skills necessary to communicate with health care providers in the future. He explained:

> *"It would be nice if maybe they explained to them in a little bit more detail of what the program could do for them, as far as what having a positive relationship with their pharmacist. You know, what follow-up questions you need to ask, have it in writing, make sure that, um, you get the answer that you need. Things like that, instead of just coming in and telling you the pharmacist will give you call."*

The attendee thought that this information would improve participants' understanding of the program's value.

4.1.2 Focus Group Session: New Riverview Apartments Residents

The focus group session that was conducted with residents of the New Riverview Apartment complex also took place on a Friday afternoon. The session was held in a small, beige activity room that was filled with tables, chairs, and bookshelves. The session began with two women, both Caucasian, who had been asked to join by the service coordinator at the apartment

complex. As the session progressed, two additional participants, both Caucasian females, joined. All participants resided in the New Riverview Apartment complex. *Table 4* lists the frequency that each theme was communicated during the session. Representative quotes were chosen to describe reported themes. Despite the similarity in theme, the information provided by the New Riverview Apartments residents, who had not utilized the HomeMeds program services, presented very different perspectives than individuals who had participated in the program.

Initially, participants expressed skepticism over the **benefits of the HomeMeds program** compared to their existing health care. One participant explained *"What happens if a pharmacist disagrees with it and yet I've been taking it all these years? And why?"* Similarly, another participant stated:

> *I think there may be a possibility that I would call the doctor and say to him 'should I participate?' And see what that thought was. . . I'd want to know; do you actually benefit from what you learn from what they show you and what they figure out?"*

However, as the focus group progressed, the initial skepticism about the program decreased and participants stated that they didn't see any harm with having an additional service check their medications. This occurred after receiving more details about the program goals and what participation in the program entailed. One particpant commented, *"it sounds helpful and it sounds like you're being protected in what you are taking."*

The most commonly coded theme in the New Riverview transcript related to the participants' **health care self-efficacy**. The participants were confident in their health care self-efficacy and skills to appropriately manage their medications. Similar to the Jewish Community Center focus group session, participants described using regular practices to track their

medications, such as maintaining a list of their prescription drugs that they took to medical appointments. For example, one participant explained, *"I have a list because when I go to the doctor, you know, to give to him to check."* They felt that the mechanisms they currently had in place were adequate for facilitating successful health care maintenance. When asked about potential challenges they faced with managing their medications, they explained that they did not experience any issues. According to one participant:

> *"No, because I carry with me, not down here, but like when I go to the doctor, I have on a piece of paper my AM and PM medications. And after they examine me, and I ask them: 'Do I need another medication?' And if they say 'yes,' I take that out."*

Additionally, participants expressed the ability to communicate openly with their medical providers. They felt that if there was a perceived problem with their medications, they could speak to their doctor about it. One focus group member reported, *"Listen if I couldn't talk to them, what is the purpose of having them."*

This leads to the second most commonly coded theme from the New Riverview session: **trust in health care providers**. Unlike the participants in the Jewish Community Center focus group, the New Riverview residents reported firm trust in their medical providers. For example, when asked if they ever had concerns about the medications that they take, one participant stated, *"Mine are prescribed by the doctors and they know everything."* Additionally, participants reported that the health care system was conducive to accurate communication between their clinicians. According to one participant:

"I go to Pitt doctors, cause I have UPMC, and they can all just pull it up on the screen and see what I take. I mean my PCP doctor, my pulmonary doctor, my orthopedic doctor. They all know because they all belong to Pitt."

In addition to this, one participant felt that because they had so many clinicians involved in their health care, they should be over-protected from potential medication harms. She reported,

"Because so many medical people have looked at my list and no one has ever said anything, ugh, I'm assuming they're all working with each other."

There was a minority opionion expressed in the group that medical providers may not have a comprehensive understanding of an individual's health care needs. The participant explained:

"Well, it's turned into now, I have many doctors. I don't just have one. And I really question 'do each of them look at what the other doctors given me?'"

In relation to the theme of **knowledge and beliefs about medication**, participants reported knowledge that medications can have different effects on individuals. For example, a participant explained, *"of course it doesn't mean it's gonna work for every person the same way."* One woman also expressed some concern over the ability for her body to handle the drugs that she takes. For example, she stated:

"Many times, I question 'How much are you going to give me.' You know what I mean? How much different things can the body take? . . . I'm always afraid that it shouldn't all of a sudden react opposite than what it's supposed to do."

Despite this, since negative reactions with her medications had not already occurred, she felt that these issues were not likely to be a problem. Additionally, the focus group members felt that **utilization of pharmacy resources** was a way to ensure medication safety. One participant commented, *"A lot of people tell you pharmacists know more about medicine than doctors do."* As a result, they agreed that they would consider participating in the HomeMeds program.

One negative aspect of the program that the participants discussed related to **privacy** and the potential for a breach of confidentiality with sensitive health care information. Participants expressed concern that their information would not be protected. One participant commented:

> *"Well I wouldn't want it discussed with someone else unless they told me who and why. It has to be confidential. But if they told me who it was and what was the purpose, I'd make up my mind of whether you should or shouldn't discuss it."*

Additionally, they explained that they would be reluctant to participate if the New Riverview Apartments staff did not clearly endorse and advertise the program. One woman stated:

> *"Yeah. I mean if Misha [service coordinator] came out and said someone's going to come up and give you a flyer, you know it's a legitimate thing."*

Because the program was operated through AgeWell Pittsburgh, an organization that was familiar to most participants, they reported that this would positively influence their decision to take part in the HomeMeds program. However, participants thought that they would be most likely to utilize HomeMeds services if they had a friend who had a positive experience with the program. Their recommendations for **operational improvements** were that a summary letter be sent to their home

before the pharmacist called them with the results of their review. Participants felt that they would not be able to understand the pharmacist's findings without a document to help guide the discussion. One individual explained:

> *"I would think it would work better if they sent out a letter with their findings and then the name and a phone number of somebody you could call if you had any questions about that information. I'm on enough meds, I don't want anybody telling me over the phone because there's too many of them."*

Additionally, they felt that the communication between the HomeMeds pharmacist and their health care provider was essential for addressing possible issues with their medications. Though they had previously discussed their ability to openly communicate with their doctors, participants did not feel equipped to lead conversations that might challenge the recommendations provided by their primary care doctor. When discussing the importance of having the pharmacist communicate directly with their primary care doctor about the findings, one particpant explained: *"They could fight the battle. I don't know what to say to the doctor."*

Overall, the New Riverview Apartments focus group participants felt that the program was a beneficial service for individuals with complex medications and health care issues. Their main concern was that information would not be kept confidential and the HomeMeds staff member may not be adequately trained or a licensed health care professional. Because the participants had trust in their health care providers and the health care system, they did not express a serious need for the HomeMeds program. However, if the previously mentioned concerns were addressed and adequately explained, they felt that there was no harm in utilizing the services provided by the program. As a result, all of the Riverview Apartments focus group members agreed that they would consider participating in the program.

4.1.3 Key Informant Interview: Jewish Association on Aging Nurse Navigator

The interview with the nurse navigator from the Jewish Association on Aging was conducted over the telephone and lasted approximately 15 minutes. Due to technical limitations, the interview was not audio recorded. However, detailed notes were taken during the interview to record the nurse navigator's responses. Given the nurse navigator's role in the operation of the HomeMeds Program, the interview transcript was coded with different themes than those used to analyze the data from the focus group sessions. The Jewish Association on Aging provides senior and low-income living facilities, skilled nursing and rehabilitation facilities, home healthcare programs, and other health-related services to older adults in the greater Pittsburgh area. Details on the themes for the key informant interviews are included in the *Appendix. Qualitative Data Codebooks.* The most commonly coded theme (*see Table 5*) from this key informant interview related to the **intervention process** of the program as operated by the Jewish Association on Aging.

Table 5. Key Informant Interviews: Themed Response Frequency

Theme	JAA Nurse Navigator	Giant Eagle Pharmacist	Geriatric Clinical Pharmacist
Intervention Process	5	5	4
Program Recruitment	3	1	0
Tracking Data	0	3	3
Client Attitudes	2	2	1
Clinician Response	0	4	3
Common Medication Issues	0	3	6
Recommendations for Improvement	0	3	2
Challenges	3	7	3

The nurse navigator explained that when the program was provided to patients who received home healthcare, the client's information is first reviewed by a nurse as a part of their

routine medical care. If the nurse was concerned about the medications the client was taking or if they had numerous prescriptions, the patient would be referred to the HomeMeds program. The nurse navigator would then enter the medications into the HomeMeds database for review by the Giant Eagle pharmacist. For individuals who did not receive home healthcare, but were living at the Jewish Association on Aging residential sites, the nurse interventionist would recruit them by directly approaching them about participation.

Subsequently, the second most commonly reported theme during this key informant interview related to **program recruitment**. When attempting to recruit participants at Jewish Association on Aging sites, and not specifically through home healthcare programs, the nurse navigator explained:

> *"It's like speaking to a deaf audience, they have no clue who I am. They don't know me at all."*

As a result, she communicated that recruitment of individuals who do not receive home healthcare through the Jewish Association on Aging was the most common challenge she experienced. Consequently, the nurse navigator reported that her primary source of clients for the HomeMeds program was through the referral by home healthcare staff members. Otherwise, she reported that recruitment at the Jewish Association on Aging community residencies was essentially nonexistent and that individuals located at this site were not utilizing the services provided by the HomeMeds program.

4.1.4 Key Informant Interview: Giant Eagle Pharmacist

The interview with the Giant Eagle clinical pharmacist was conducted over the telephone and lasted approximately 30 minutes. The interview was transcribed verbatim and coded with the same themes used for all of the key informant interviews. A team of eight pharmacists provide services for the HomeMeds program. However, the pharmacist interviewed for the purposes of this project was the main contact person for the HomeMeds program. Starting with the most common theme coded from the interview session (*see Table 5*), the pharmacist reported many **challenges** with implementing the program. The pharmacist cited that communication with HomeMeds staff, nursing facility staff, and clients were the main challenges that the Giant Eagle team experienced with the program. Oftentimes, efforts to relay information from the HomeMeds medication assessment were difficult because the client did not know the Giant Eagle pharmacist or remember participating in the program. Because older adults were especially prone to scams, this presented a challenge even when the pharmacists were persistent and clear in their follow-up communication about the program. For example, she stated:

> *"A lot of, you know, the issue with it on our end, other than, like, the paperwork and stuff . . . is just like the skepticism around it is definitely a big issue – I think communication is definitely something we could improve upon."*

Furthermore, if the client utilized home healthcare and the pharmacist tried to communicate with nursing facility staff, the pharmacy team experienced similar difficulties with communication. She explained:

"Sometimes times we do have a little bit more trouble talking to the nursing facility cause we have to leave messages and it's, it's a little bit more cumbersome to get a response."

Tracking data was one of the third most-frequently coded themes in the data analysis of the interview transcript. With regard to tracking data, the pharmacist reported that there were occasional errors in the information that was provided in the HomeMeds database. However, overall the information was accurate. She explained:

"I think definitely, um, as far as like just kind of going through the medication list, sometimes there can be like, you know, errors made or typos, things like that. But, I think for the most part we get generally accurate information."

Additionally, the pharmacist described the comprehensive list maintained by the Giant Eagle pharmacy team that tracks information on every client with flagged medications in the HomeMeds database. Each month, the pharmacists reviewed this information and sent it back to the HomeMeds staff at AgeWell Pittsburgh. The pharmacist described the process for tracking this information:

"I go through the spreadsheet and try and filter out, like, who we talked to, who we actually completed assessments with, um, and the assessments we addressed—we try to filter through how many therapy duplications do we have, how many NSAID indications."

This leads to the **recommendations for improvements** provided by the Giant Eagle pharmacist. Conducting this additional review of HomeMeds clients each month was reported as

time-intensive. As a result, the pharmacist recommended investigating whether this information could be provided directly from the HomeMeds database to reduce the time devoted to performing this task. She explained:

> *"At this point, it's such a manual process, we are hoping there is something that maybe we don't know about and we are also trying to figure out what AgeWell really needs from us. We don't know if we're providing it because that's how it's always has been. Do they really need it? Cause if not, we're doing a ton of work on the backend."*

Additionally, enhancing awareness about the program could improve communication between the pharmacy and nursing staff. The pharmacist communicated that while some site staff were well-educated about the program, others were often confused when the pharmacist placed follow-up calls about clients. Providing additional education about the program at these sites may facilitate better communication between Giant Eagle pharmacists and the home health staff members.

Common medication issues that the pharmacist cited during the interview were therapy duplications, nonsteroidal anti-inflammatory drugs (NSAIDs) prescribed for individuals over the age of 80, and possible harmful interactions between prescriptions and over-the-counter vitamins. They felt that these issues were most commonly found in clients who had complex health care needs that required multiple medications. This was most frequently seen in the clients who participated in the HomeMeds program operated through the Jewish Association on Aging. The pharmacist stated:

> *"I think, a lot of the times, specifically with the JAA patients that are in the home health program, a lot of the times it is like they're on a lot of stuff cause they're really sick and they have a lot of issues going on."*

Consequently, they felt that the program was a useful resource for reviewing and identifying potential medication errors for the population of older adults with complex medication needs.

Despite this, the pharmacist reported that because the program did not track outcomes, it was difficult to know whether a client's health actually improved as a result of the intervention. Moreover, when the prescribing physician was contacted about a medication error or risk of an adverse drug event, the pharmacist reported that they rarely received a follow-up response. As the pharmacist explained, providers were typically contacted via fax machine with their findings from the medication risk assessment. It was uncommon for the pharmacist to call the physician directly about the program. As a result, overall, the Giant Eagle pharmacy team had very limited communication with the client's regular health care provider. In the uncommon occurrence that there was a response, the physician was oftentimes already aware of the risks associated with the client's prescription drugs. The pharmacist explained that some responses she had received were:

> *"I think one or two faxes I've gotten back were kind of generally like 'This medication is needed. Not changing.' Or something like that . . . They kind of say, you know, 'We're aware of the risk.' But, um, like, benefit outweighs the risk in a lot of cases, so it is kind of, like, their clinical judgement call."*

Subsequently, as explained by the responses related to the **intervention process** theme, a large part of the Giant Eagle pharmacy team's role in the HomeMeds program was to understand why a client was taking a certain medication and if their findings were clinically relevant. As the pharmacist explained, alerts that were generated in the system did not always require a follow-up

call with the client or their physician. When a client's medications were reviewed, the team assessed whether an alert warranted a follow-up consultation with the client. Sometimes, these alerts did not require additional intervention. However, if an alert was a concern to the team, they contacted the client with their findings and requested to contact their prescribing physician. The pharmacy team attempted to reach the client three times by telephone. If the pharmacist was unable to speak with the client, they would send a letter to their home and request that the client contact them to discuss the results. Due to HIPAA restrictions, no sensitive health information was included in these letters. Overall, the pharmacist reported that streamlining the communication between her team and the HomeMeds staff and clients would help to *"ease up a chunk of time on our end."*

4.1.5 Key Informant Interview: Benedum Geriatric Clinical Pharmacist

The interview with the geriatric clinical pharmacist was conducted during an in-person meeting. Due to technical limitations, the interview was not audio recorded. However, detailed notes that recorded interview responses were documented. The information provided during the interview was coded with the same themes that were used for the other key informant interviews. The most common comments (*see Table 5*) from the geriatric clinical pharmacist related to **challenges** with medication management for older adults. The pharmacist explained that medication errors are most frequently associated with transitions of care. She explained:

> *"Major mistakes with discharging people from the hospital and clinical errors occur between the initial discharge and follow-up appointments. Oftentimes, what is listed on the print-out that is given to the discharged patient*

is incorrect and they have no way of checking this until they see the doctor again."

Consequently, she commented that it was worthwhile for the program to identify **common medication issues**, such as therapeutic duplications, which frequently occur during transitions of care. However, based on comments related to the **intervention process**, the geriatric clinical pharmacist questioned the value of the program. Her main basis for this related to the lack of communication between the partnering Giant Eagle pharmacists and the participant's primary care providers.

The clinical pharmacist explained that, although the HomeMeds software would identify therapeutic duplications and potential risks with medication dosage, partnering Giant Eagle pharmacists would need additional clinical information about the patient to provide meaningful recommendations. She explained:

"The software is not going to catch the things that matter. It will catch the easy things like duplications or extreme interactions. But knowing if drugs are appropriate for a person is much harder."

Additionally, if the participant had some sort of unknown cognitive impairment, providing recommendations to them without consultation with their primary physician may be problematic and could result in harm. Possible cognitive impairments and other errors may also impact the initial **tracking of data** during the assessment. For example, the pharmacist questioned the accuracy of the data entry by the HomeMeds staff. She explained, even with proper training, mistakes that occur frequently in the healthcare system may be just as common in the recording of patient information during the medication assessment. Moreover, she explained:

"I would worry about the accuracy of the intake and inventory of the medications. Are they checking how the patient currently takes the medications? Medications may change, but bottles don't."

Because UPMC and Highmark insurance companies already utilize a form of HomeMeds *Plus*, which includes the medication assessment, review of the patient's home environment, and linkage to additional services, the geriatric clinical pharmacist was unsure of whether the program was more valuable than the regular care available to these patients. The pharmacist did note the value of the program if it was able to target individuals from underserved backgrounds who might not have access to or utilize regular care.

The **recommendations for improvement** provided by the geriatric clinical pharmacist were to have key staff, such as the service coordinator at the New Riverview Apartments, identify individuals who are most in need of the HomeMeds services. In addition, the pharmacist suggested partnering with a local medical provider who serves underrepresented patients and could recommend participants for the program.

4.2 Quantitative Findings

A total of 1,045 medical assessments conducted by the HomeMeds program were included in this study. The average HomeMeds client is an 82-year-old female who takes 10 medications. The most commonly diagnosed condition reported in the HomeMeds database is hypertension, which was found in 54.0% of the program clients. Additionally, 52.0% of HomeMeds participants reported a hospital or emergency department visit in the past three months (*see Table 6*).

Table 6. HomeMeds Participant Incidents & Symptoms

Incident/Symptom	Total Participants
Fall	204
Dizziness	150
Confusion	65
Hospital/ER Visit	541

Of the total assessments, 1,028 had medications entered into the HomeMeds database. Almost 60% of the medication assessments conducted through the HomeMeds program generated an alert within the database (*see Table 7)*. The majority of alerts were for the use of NSAIDs in 80-year-old individuals. However, it should be noted that out of the 604 assessments that generated alerts, only 207 of these alerts (34.3%) warranted a follow-up discussion between the client and the

Table 7. HomeMeds Program Activities Summary

HomeMeds Activities	Total Participants
Medication Assessments	1045
Assessments with Medications Entered	1028
Assessments with Alerts	604
Assessments Reviewed by the Pharmacist	207
Assessments with at Least One Resolution	207
Assessments with Unresolved Alerts	65
Assessments with Contact to the MD	16

pharmacist. The explanation for this discrepancy was that all alerts did not require follow-up with the HomeMeds client. After the pharmacist reviewed the assessment, they may have found that the generated alert did not require intervention due to the information provided in the client's profile (*e.g.* current medical conditions, health history, etc.). However, for the alerts that required intervention by the Giant Eagle pharmacist (*i.e.* follow-up communication with the client), all resulted in at least one resolution. Additionally, approximately 2.6% of assessments that generated an alert and were reviewed by the pharmacist resulted in additional contact with the prescribing doctor.

Chi-square analyses indicated that individuals who took five or more medications were significantly more likely to have an alert generated in the HomeMeds database during their assessment than those who took fewer than five medications (93.5% vs. 6.5%; χ^2 = 69.1[3, n =1045]; p <0.001). Additionally, there was a significant difference (χ^2 = 194.2 [3, n =1045]; p < 0.001) between observed alerts that required intervention by the pharmacist and the alerts that did not require further involvement. As a result, alerts that were generated within the database were more likely to not require intervention after the pharmacist review than to require additional intervention (65.7% vs. 34.2%). There was also a significant difference (χ^2 = 45.4 [3, n =1045]; p < 0.001) between the clients who reported falls and a hospital or emergency room visit in the past three months and those who had fallen, but reported no hospitalization (71.1% vs. 29.0%). Compared to individuals who did not report a fall in the past three months, those who did were significantly more likely to also report visiting a hospital or emergency room.

5.0 Discussion

5.1 Summary of Results

Overall, the findings from this study indicate clear differences in perspectives about the HomeMeds program between members of the target population who were former clients and those who had not used its services. These differences identify potential barriers to recruitment for the program. To start, it should be noted that the members of the focus group session with previous HomeMeds clients regularly used the services offered at the Jewish Community Center and had utilized other AgeWell Pittsburgh programs. They were also familiar with the AgeWell Pittsburgh staff, which may have influenced their participation in the focus group session. For example, when recruiting potential focus group members, mentioning the name of the AgeWell staff member who had referred them helped to endorse the study and likely supported their decision to participate. Likewise, this same familiarity with the organization and the AgeWell staff member who would be conducting the HomeMeds medication risk assessment may have had a significant impact on these individuals' initial decision to participate in the program.

The importance of trust and pre-existing relationships between HomeMeds staff and potential clients was evident in the findings from the session with the New Riverview apartments residents. This was first apparent in the coordination of the focus group session at this location, as recruitment for the session was conducted solely by the New Riverview Apartments service coordinator. Unlike the members of the session at the Jewish Community Center, these residents were not familiar with AgeWell staff members who conducted HomeMeds activities. Additionally,

as identified by the nurse navigator, lack of familiarity between HomeMeds staff and individuals at AgeWell residential sites contributed to significant challenges with recruitment for the program.

This relates to an interesting theme that was not pre-determined and emerged during both focus group sessions: trust in health care providers. The previous HomeMeds clients indicated that the program served as a comprehensive review of their medications, which they would have otherwise not received in their routine medical care. Conversely, the majority of New Riverview focus group members indicated that, although it was not harmful to have an additional review of their medications, their current medical care was sufficient in keeping them safe. This difference in perspective is likely to stem, in part, from a lack of knowledge about the potential for errors in prescribing and inaccuracies in the electronic medical record. Consequently, without adequate understanding of the possible errors that exist in the electronic medical record, difficulties in care coordination between numerous health care providers, and risks for adverse drug events with multiple medications, the members of the target population may be reluctant to participate in a program for which they do not perceive a significant need.

Additionally, previous participants felt that the program had improved their knowledge about medications and enhanced their health care self-efficacy. Participants cited that taking part in the HomeMeds program motivated them to engage in discussions with their health care providers and pharmacists about their medications. Therefore, in addition to the benefit of the medication risk assessment, participating in the program also heightened awareness about medication errors and served as a cue to action to take additional steps to maintain health. In comparison, the New Riverview residents initially reported skepticism about the utility of the program as they did not perceive challenges with their health care self-efficacy. However, a surprising finding was that as the session progressed, discussions about the goal of the program

(*i.e.* explaining potentially inappropriate prescribing and the need to prevent it) seemed to shift this perspective among the members. Additionally, the minority opinion expressed by one participant about the possible lack of communication between her clinicians helped to bring awareness of this issue to the group. Therefore, simply discussing the prevalence of potentially inappropriate prescribing in the health care system contributed to the focus group members' understanding of the utility of the program in enhancing their health care self-efficacy.

Data from the key informant interviews primarily related to the challenges experienced by staff and partnering pharmacists and noted by the geriatric clinical pharmacist. The main problems that were identified rose from difficulties with communication. These issues were reported at all levels, including between staff and potential clients for recruitment, clients and pharmacists about recommendations, and pharmacists and primary care providers with medication assessment results. Additionally, findings from key informant interviews related to the intervention process for each of the program personnel: staff and partnering pharmacists. The information provided in these interviews led to identification of possible opportunities to address issues with the intervention process and enhance the services provided to the HomeMeds clients.

The main concerns with communication that were expressed by the partnering pharmacist were that given the lack of communication with primary care providers and reliance on clients to relay key information about their medications, partnering pharmacists faced challenges with providing clinically-relevant recommendations. Though the information collected about the client allowed for some understanding of their clinical history, lack of access to their medical record resulted in gaps in knowledge. As noted by the geriatric clinical pharmacist, additional issues with communicating results to clients were the possibility for a client's cognitive impairment or difficulty interpreting the pharmacist's recommendations. Without a direct line to the client's

primary care provider, the program was not conducive to allowing partnering pharmacists to make an informed judgement about the client's medications and ensure follow-through with their suggested changes.

The quantitative findings of this study provide evidence that members of the target population who participate in the HomeMeds program are, indeed, at an increased risk for health complications that arise from medications. Almost 90% of HomeMeds clients took five or more medications, indicating that they experienced polypharmacy in their routine medical care. Moreover, quantitative findings evidenced that clients who took five or more medications were more likely to have an alert generated in the system than those who took less medications. Additionally, the clients who had experienced a fall, a common outcome of an adverse drug event, were also more likely to report an emergency room visit or hospitalization. Thus, the quantitative data in this study supports the evidence that polypharmacy is associated with an increased risk for adverse drug events, which are also associated with increased health care utilization. Additionally, given the high number of participants who were experiencing polypharmacy in their medical care, the quantitative findings indicate that the HomeMeds program was successful in reaching a majority of individuals who were technically at risk for an adverse drug event.

Despite this, the majority of alerts that were generated in the system did not require follow-up communication between the pharmacist and the client. This suggests that, upon review, the alerts were determined to be clinically insignificant and did not necessitate remediation by the partnering pharmacist. These quantitative findings further support the qualitative data reported by the partnering and geriatric clinical pharmacist that the risks identified within the database were likely to be outweighed by the benefit of the medication for the client. However, it should be noted that given the partnering pharmacist's gaps in knowledge about the client's treatment, these

determinations were made without a full understanding of the client's medical history. As noted by the geriatric clinical pharmacist, aside from addressing therapeutic duplications that were easily identified by the HomeMeds software, the medication review and subsequent determinations about the safety of the client's prescription and non-prescription drugs was limited. Furthermore, because follow-up information was not recorded, it was impossible to measure whether the pharmacist's recommendations or lack thereof actually prevented or delayed additional hospitalizations.

Among the alerts that did require communication from the pharmacist and the client about their medications, the majority of these discussions did not result in additional contact with the primary care provider. It is possible that this is because medication issues were resolved without intervention from the primary care provider. However, it is also possible that clients did not consent to contacting their primary care provider, even if the partnering pharmacist recommended further communication. One possible explanation for this is the concern reported during the New Riverview focus group that recommendations provided by an outside pharmacist may question their primary care provider's expertise, which could negatively impact the client's relationship with their doctor. Accordingly, this same concern may have also contributed to client's reluctance to communicate results from the medication risk assessment to their primary care provider.

There are several limitations to this study. One of the main limitations was that only two focus groups were conducted for qualitative data collection. Due to time constraints and difficulty with recruiting participants, it was not possible to conduct multiple focus group sessions with members of the HomeMeds target population. Therefore, thematic saturation was not achieved. Furthermore, despite efforts to conduct focus group sessions with past participants who had diverse experiences with the HomeMeds program, it is likely that those who chose to participate had a positive experience with the program and the other AgeWell Pittsburgh services. Thus, feedback

provided by previous HomeMeds clients may have been biased. Subsequently, there was limited generalizability of the findings discovered during the focus group sessions outside of the two groups of the target population that were examined. Finally, only one key informant interview was audio recorded. The other two interviews were documented using descriptive notes. As a result, it is likely that data from these two key informants were lost during the interview process.

In addition to limitations to the qualitative data, the quantitative data had limitations. For instance, it was not possible to identify the client profiles with assessments that resulted in follow up communication with their primary health care provider. Therefore, review of these clients' medication assessments was not possible. Consequently, possible factors that may have contributed to communication with the primary care provider were not identified. Without this information, strategies to increase the communication with medical providers, which may have otherwise enhanced the recommendations for the program, were limited. Finally, the quantitative data provided in the HomeMeds database was a result of information collected from clients across the AgeWell Pittsburgh sites. However, the qualitative data in this study was limited to affiliates of AgeWell Pittsburgh at the Jewish Community Center and residents at the New Riverview Apartments. As a result, to strengthen the findings of this study, the quantitative data analysis should have been limited to these two sites within the AgeWell Pittsburgh organization. However, it was not possible to filter the data by AgeWell Pittsburgh site.

One strength of this study is that it is the first known formal mixed methods evaluation of the HomeMeds Program at AgeWell Pittsburgh. The use of mixed methods provided qualitative data that enriched and clarified the quantitative findings from the HomeMeds database. Additionally, through the use of focus group sessions with members of the target population and key informant interviews with various HomeMeds staff and experts in geriatric pharmacy, the

qualitative data includes a variety of valuable perspectives to help inform next steps of the program. Other strengths are found in the comprehensive set of information available in the HomeMeds database that provided the quantitative data for this study. Though accessing clients' health history was identified as a challenge for pharmacists, the information in the HomeMeds database provides a valuable snapshot of the demographics, diagnoses, and medications of over 1,000 older adults in Pittsburgh. Consequently, the HomeMeds database was a useful tool for understanding the health care issues commonly experienced by this population.

5.2 Recommendations for Improvement

Given the findings of this study, possible future directions for this program should focus on improving recruitment with individuals at the AgeWell Pittsburgh residential sites who do not receive home healthcare. This begins by improving knowledge about medications and risks associated with potentially inappropriate prescribing among these individuals. The members of the target population who had not utilized the HomeMeds services initially expressed skepticism about the overall benefit of participating in the program and confidence in the infallibility of the healthcare system and electronic medical record. As exemplified by the Health Belief Model, an individual is more likely to partake in a health-related behavior if they have a desire to identify or avoid a particular health outcome and if they believe that a certain action will prevent this outcome. In order to achieve this health-related behavior, the individual must first understand their susceptibility for a specific health outcome. This is also demonstrated by the shift in the New Riverview residents' perspectives about the program after understanding the prevalence of inappropriate prescribing in the health care system. Thus, the first step in improving recruitment

among this sect of the target population is to provide education to raise awareness about the prevalence of adverse drug events among older adults, potentially inappropriate prescribing by health care providers, and therapeutic duplications that often occur during transitions of care.

According to the Health Belief Model, individuals must also understand the severity of experiencing a particular health outcome to partake in a specific health-behavior. Subsequently, education for the target population should include information about the consequences (*e.g.* hospitalization, reduced cognitive ability, failure to complete activities of daily living, and death) that may result from these risks. While these consequences may induce fear, the Health Belief Model conceives that, with the availability of a specific health-behavior that might prevent this outcome, individuals will have an increased desire to perform this particular action. However, the Health Belief Model also theorizes that the benefits to engaging in this behavior must outweigh the barriers to participation. As noted by the New Riverview residents, a significant barrier to their participation in the program was lack of trust in the staff member conducting the HomeMeds activities and fear of breach of confidentiality. Consequently, members of the target population must be confident that the individual performing their medication risk assessment is a legitimate, trained staff member and that information is not documented outside of the secure HomeMeds database.

While it is clear that current recruitment efforts include various aspects of the Health Belief Model, possible ways to improve the program should shift how information is relayed to potential clients. A key asset to the HomeMeds program is its partnership with community pharmacists, who are specially-trained to communicate medication information to non-clinicians. As a result, the HomeMeds program should leverage the partnering Giant Eagle pharmacy team to educate members of the target population about polypharmacy, adverse drug events, and potentially

inappropriate prescribing. One way to do this is to host an educational session led by partnering pharmacists at AgeWell Pittsburgh sites. This forum could be used to provide the information necessary for individuals to increase their understanding of the susceptibility and severity of these medication risks. Additionally, because community pharmacists are well-regarded medical providers who often interface with patients, their promotion of HomeMeds may help to overcome skepticism about the program and elicit participation. Even if attendees do not participate in the program, the information provided during the educational session may improve their health care self-efficacy and enhance their ability to engage in future communication with clinicians about their prescription and non-prescription drugs.

Another possible change in the operations of HomeMeds would be to utilize program champions to encourage participation. Sites that have the most success with recruiting individuals to the program often benefit from a HomeMeds staff member who interacts frequently with affiliated members of the target population. For locations that do not have a HomeMeds staff person regularly present, partnering with other staff members at the site may help to promote the program. Additionally, these staff members may have specific knowledge about individuals to help identify those most in need of the HomeMeds services. Without this knowledge, it is likely that individuals from these sites who choose to participate already have an increased awareness about their perceived risk and susceptibility for medication issues. Therefore, they may already engage in conversations about their prescription and non-prescription drugs with their medical providers.

In addition, given their willingness to partake in this program, it is possible that these individuals are already linked to other services that help them to maintain their independence. Thus, it is possible that recruitment efforts at these sites fail to connect with vulnerable older adults

in need of a medication risk assessment. The inclusion of a program champion at sites that experience difficulties with recruitment would also serve as a valuable endorsement of HomeMeds. This is especially important for engaging with individuals who are wary of involving additional services in their medical care. As a result, the involvement of a program champion may enhance engagement with vulnerable individuals and diminish the perceived barriers that interfere with their decision to participate in HomeMeds.

Finally, as reported by the partnering Giant Eagle pharmacist and the geriatric clinical pharmacist, a significant challenge to the operations of the program is the lack of comprehensive information about the client's health when making clinical decisions. Without this crucial information, the work required to make a sound clinical judgement and provide recommendations may be futile. Subsequently, possible future considerations for the HomeMeds program should include a partnership with a local primary care practice. Similar to the involvement of a program champion, a partnership with a local medical provider could improve the program's outreach to the older adults who have the greatest need for assistance with medication management. For example, the health care provider could also recommend the HomeMeds services to clients who have recently experienced a transition of care or have complex medication regimens. Additionally, through this partnership, the Giant Eagle pharmacy team could have access to the critical information that is necessary when making clinically-meaningful recommendations about a client's prescription and non-prescription drugs.

It should be noted that evidence from a systematic review of other medication management programs for older adults did not find a significant decrease in the hospitalizations, emergency department visits, mortality, quality of life, mental health or physical function among program participants[54]. Thus, in order to truly understand the value of the AgeWell Pittsburgh

HomeMeds Medication Assurance Program, opportunities to evaluate client outcomes must be a priority. Through a partnership with a local primary care practice, the program could track the outcomes of clients to measure whether participation in the program has a positive impact on their health. Evaluations could examine client's health care utilization, changes to prescription drugs, and mortality 6- and 12-months after their medication risk assessment. As a result, this information would provide a better understanding of the overall utility of the program in preventing or delaying adverse health outcomes that are caused by medications among participants.

6.0 Conclusion

Overall, the HomeMeds Medication Assurance Program that is operated by AgeWell Pittsburgh is a noteworthy service to keep older adults safely at home through the identification of medication errors and the prevention of adverse drug events. This program attempts to obviate the individual-level consequences and health system-wide challenges that stem from these medication issues. However, considering the program challenges with recruiting vulnerable older adults, limited information provided to partnering pharmacists, and the intervention activities that occur after medication risk assessments, other avenues for driving this mission should be explored. Future considerations for HomeMeds should focus on addressing each of these key challenges to improve the implementation of the program and enhance its services.

While it is clear that the majority of AgeWell clients experience polypharmacy and are susceptible to the associated risks, recruitment for the program will be stagnant if members of the target population have limited knowledge about this issue. One of the main benefits of the program that was cited by previous participants was improved knowledge about medication errors and health care self-efficacy. Thus, employing a community pharmacist to educate the target population about medication risks may help older adults at AgeWell sites understand the importance of this problem. Focusing recruitment efforts on first providing education to the target population may motivate older adults to utilize the HomeMeds program and encourage communication with their primary care providers about medications. These efforts could help to improve participation at sites that experience the most challenges with recruitment while also enhancing individuals' self-efficacy when engaging with medical providers.

Furthermore, though HomeMeds is a useful program to promote proper medication management, older adults may be reluctant to involve a service that requires providing sensitive health care information to individuals with whom they do not have a pre-existing relationship. This may be especially true for older adults who experience issues with linkage to and engagement with care—individuals who have the most need for a program like HomeMeds. However, designating an AgeWell staff member as a program champion could help to identify and elicit participation from vulnerable individuals in this population. This would ensure that the HomeMeds program reaches the older adults who are otherwise unlikely to use additional health care services or consult regularly with their medical providers. By leveraging a program champion at AgeWell residential sites, HomeMeds would have more success with outreach to the vulnerable older adults who would benefit the most from a medication risk assessment.

Other considerations for HomeMeds should include improving program operations so the Giant Eagle pharmacy team has access to the information necessary for providing meaningful recommendations for medication risk assessments. The majority of alerts that were generated in the HomeMeds database were determined to be clinically insignificant. Thus, efforts to implement the program may be futile if the benefits of certain medications ultimately outweigh the associated risks for the majority of HomeMeds clients. Partnering with a local primary care practice in Pittsburgh would help ensure that pharmacists' recommendations are accurate and the operation of the program is worthwhile. Finally, a partnership with a local primary care practice could facilitate evaluation of the program. Aside from identifying therapeutic duplications or problems with non-prescription medications, it is likely that HomeMeds is limited in its ability to significantly address potentially inappropriate prescribing in older adults. To truly understand the utility of the program, follow-up evaluations of clients are needed. This information is crucial to

understanding whether the program is consistent with emerging literature that similar interventions do not cause a significant change in clients' health outcomes. Future directions for the HomeMeds program should involve evaluation of client health outcomes to measure the program's ability to keep older adults living safely and independently in their homes.

Appendix. Qualitative Data Codebooks

Appendix Table 1. Focus Group Session Codebook

Code	Definition	Included Concepts
Benefits of program	Perceived or real positive outcomes that resulted from participation in the program	- Prevention of adverse drug events - Identification of medication errors - Assistance with medication management - Safeguards medications
Privacy	Data security and confidentiality	- Disclosure of sensitive information - Professionalism of staff - Legitimacy of program
Health care self-efficacy	An individual's ability to execute the actions necessary to achieve a state of physical, mental and social well-being in which disease and infirmity are absent	- Medication management practices - Ability to communicate with clinicians - Confidence in independent health maintenance
Challenges with managing medications	Problems associated with medication adherence	- Confusion about medications - Complex medication routines - Mistakes made when taking medications
Knowledge and beliefs about medication	Understanding of basic medication information and knowledge about medication errors; health-literacy	- Awareness of adverse drug events, prescribing errors - Effect of individual physiologic factors on drug reaction
Trust in health care provider	Belief in the reliability and proficiency of medical providers to execute the actions necessary to promote an individual's health	- Provider's understanding of client's medical needs - Communication with healthcare provider - Accuracy of the electronic medical record
Utilization of pharmacy resources	Use of pharmaceutical services; pharmacist's role in medication management and education	- Pharmacist is friend - Pharmacist knows more about medications than doctors

Appendix Table 1 Continued

Operational improvements	Functional changes to increase the capacity of the HomeMeds program to perform medication risk assessments and address medication needs for older adults	- More advertising - Program incentives - Better communication

Appendix Table 2. Key Informant Interview Codebook

Code	Definition	Included Concepts
Intervention Process	Actions executed to operate the HomeMeds program and conduct medication risk assessments for older adults	- Database entry process - Home health care mechanism for referral - Medication risk assessment review process - Communication strategies/routine
Program Recruitment	Process of adding new participants to the HomeMeds program	- Target population willingness to participant in program - Individual awareness about the program
Tracking Data	Measuring recorded information	- Client information - Accuracy of information in database - Review of client information
Client Attitudes	How clients viewed the program or personnel when carrying out program operations	- Suspicion - Lack of recognition - Grateful
Clinician Response	How physicians viewed the program or personnel when carrying out program operations	- Suspicion - Lack of recognition - Grateful
Recommendations for Improvement	Functional changes to increase the capacity of the HomeMeds program to perform medication risk assessments for older adults	- Streamlining communication - Increasing program awareness - Access to health information for medication assessments
Challenges	Difficulties in achieving program goals	- Barriers to communication - Lack of engagement with target population - Gaps in knowledge about client's health - Time

Bibliography

1. Center for Disease Control and Prevention, *Life expectancy at birth, at 65 years of age, and at 75 years of age, by race and sex: United States, selected years 1900–2007*. 2010.
2. Center for Disease Control and Prevention, *Leading Causes of Death, 1900-1998*.
3. Kochanek, KA, RN, and Arias, E, *Changes in Life Expectancy at Birth, 2010–2018*, in *Health E-Stats*, N.C.f.H. Statistics, Editor. 2020.
4. Vespa, J *The Graying of America: More Older Adults Than Kids By 2035*. America Counts: Stories Behind the Numbers, 2018.
5. Colby SL, O, JM, *Projections of the Size and Composition of the U.S. Population: 2014 to 2060*, in *Population Estimates and Projections*, U.S.C. Bureau, Editor. 2015.
6. Raghupathi, W and V Raghupathi, *An Empirical Study of Chronic Diseases in the United States: A Visual Analytics Approach.* International journal of environmental research and public health, 2018. **15**(3): p. 431.
7. Prevention, CfDC. *About Chronic Diseases*. [cited 2020 January 30]; Available from: https://www.cdc.gov/chronicdisease/about/index.htm.
8. Christine Buttorff, TR, and Melissa Bauman, *Multiple Chronic Conditions in the U.S.*, R. Corporation, Editor. 2014: Santa Monica, CA.
9. National Council on Aging. *Healthy Aging Facts*. Available from: https://www.ncoa.org/news/resources-for-reporters/get-the-facts/healthy-aging-facts/.
10. Institute, APP, *Beyond 50.09 Chronic Care: A Call to Action for Health Reform*, P.P. Institute, Editor. 2009.
11. Charlesworth, CJ, et al., *Polypharmacy Among Adults Aged 65 Years and Older in the United States: 1988-2010.* The journals of gerontology. Series A, Biological sciences and medical sciences, 2015. **70**(8): p. 989-95.
12. Office of Disease Prevention and Health Promotion, *National Action Plan for Adverse Drug Event Prevention*, Department of Health and Human Services, Editor. 2014: Washington, DC.
13. Hajjar, ER, AC Cafiero, and JT Hanlon, *Polypharmacy in elderly patients.* Am J Geriatr Pharmacother, 2007. **5**(4): p. 345-51.
14. Care, Pi. *HomeMeds Medication Safety Program* January 8, 2020]; Available from: https://www.picf.org/homemeds/.
15. Shoair, OA, AN Nyandege, and PW Slattum, *Medication-related dizziness in the older adult.* Otolaryngol Clin North Am, 2011. **44**(2): p. 455-71, x.
16. Laatikainen, O, et al., *Hospitalizations Due to Adverse Drug Events in the Elderly—A Retrospective Register Study.* Frontiers in Pharmacology, 2016. **7**(358).
17. Shade, MY, et al., *Adverse drug events reported by rural older adults.* Geriatric Nursing, 2017. **38**(6): p. 584-588.
18. Manno, MS, *Preventing adverse drug events.* Nursing2020, 2006. **36**(3).
19. Hanlon, JT, et al., *Adverse drug events in high risk older outpatients.* J Am Geriatr Soc, 1997. **45**(8): p. 945-8.

20. Nolan, L and K O'Malley, *Prescribing for the elderly. Part I: Sensitivity of the elderly to adverse drug reactions.* J Am Geriatr Soc, 1988. **36**(2): p. 142-9.
21. Pérez, T, et al., *Prevalence of potentially inappropriate prescribing in older people in primary care and its association with hospital admission: longitudinal study.* BMJ, 2018. **363**: p. k4524.
22. Hohl, CM, et al., *Polypharmacy, adverse drug-related events, and potential adverse drug interactions in elderly patients presenting to an emergency department.* Ann Emerg Med, 2001. **38**(6): p. 666-71.
23. Richardson, K, K Bennett, and RA Kenny, *Polypharmacy including falls risk-increasing medications and subsequent falls in community-dwelling middle-aged and older adults.* Age and ageing, 2015. **44**(1): p. 90-96.
24. Morrison, A, et al., *Epidemiology of falls and osteoporotic fractures: a systematic review.* ClinicoEconomics and outcomes research : CEOR, 2013. **5**: p. 9-18.
25. Boyle, N, V Naganathan, and RG Cumming, *Medication and falls: risk and optimization.* Clinics in Geriatric Medicine, 2010. **26**(4): p. 583-605.
26. Organization, WH. *Falls*. 2018 [cited 2020 March 21, 2020]; Available from: https://www.who.int/news-room/fact-sheets/detail/falls.
27. Florence, CS, et al., *Medical Costs of Fatal and Nonfatal Falls in Older Adults.* Journal of the American Geriatrics Society, 2018. **66**(4): p. 693-698.
28. Bergen, G, MR Stevens, and ER Burns, *Falls and Fall Injuries Among Adults Aged ≥65 Years - United States, 2014.* MMWR. Morbidity and mortality weekly report, 2016. **65**(37): p. 993-998.
29. Burns, E and R Kakara, *Deaths from Falls Among Persons Aged ≥65 Years - United States, 2007-2016.* MMWR. Morbidity and mortality weekly report, 2018. **67**(18): p. 509-514.
30. Green, JL, JN Hawley, and KJ Rask, *Is the number of prescribing physicians an independent risk factor for adverse drug events in an elderly outpatient population?* The American Journal of Geriatric Pharmacotherapy, 2007. **5**(1): p. 31-39.
31. Calderón-Larrañaga, A, et al., *Multimorbidity, polypharmacy, referrals, and adverse drug events: are we doing things well?* British Journal of General Practice, 2012. **62**(605): p. e821-e826.
32. Johnson, A, E Guirguis, and Y Grace, *Preventing medication errors in transitions of care: A patient case approach.* Journal of the American Pharmacists Association, 2015. **55**(2): p. e264-e276.
33. Nguyen, PV-Q and C Spinelli, *Prescribing cascade in an elderly woman.* Canadian pharmacists journal : CPJ = Revue des pharmaciens du Canada : RPC, 2016. **149**(3): p. 122-124.
34. Office of Disease Prevention and Health Promotion, *America's Health Literacy: Why We Need Accessible Health Information*, in *Health Communication Activities*, U.S. Department of Health and Human Services, Editor.
35. Oscalices, MIL, et al., *Health literacy and adherence to treatment of patients with heart failure.* Rev Esc Enferm USP, 2019. **53**: p. e03447.
36. Singh, S, et al., *Health Literacy Status and Understanding of the Prescription Instructions in Diabetic Patients.* J Diabetes Res, 2018. **2018**: p. 4517243.

37. Park, NH, et al., *The effects of medication adherence and health literacy on health-related quality of life in older people with hypertension.* Int J Older People Nurs, 2018. **13**(3): p. e12196.
38. Bailey, SC, et al., *Longitudinal Investigation of Older Adults' Ability to Self-Manage Complex Drug Regimens.* J Am Geriatr Soc, 2019.
39. Chesser, AK, et al., *Health Literacy and Older Adults: A Systematic Review.* Gerontology & geriatric medicine, 2016. **2**: p. 2333721416630492-2333721416630492.
40. Bureau, USC. *United States Census Bureau Quick Facts*. 2010 [cited 2019 December 9].
41. Health, PDo, *Injuries in Pennsylvania: 2018 County Profiles*, V.a.I.P. Program, Editor. 2018.
42. *State & County Estimates of Low Literacy*. National Assessment of Adult Literacy 2003 [cited 2020 February 2, 2020]; Available from: nces.ed.gov/naal/estimates/StateEstimates.
43. Santell, JP and RW Hicks, *Medication Errors Involving Geriatric Patients.* The Joint Commission Journal on Quality and Patient Safety, 2005. **31**(4): p. 233-238.
44. Rigler, SK, et al., *Patterns of Potentially Inappropriate Medication Use Across Three Cohorts of Older Medicaid Recipients.* Annals of Pharmacotherapy, 2005. **39**(7-8): p. 1175-1181.
45. Jetha, S, *Polypharmacy, the Elderly, and Deprescribing.* The Consultant pharmacist : the journal of the American Society of Consultant Pharmacists, 2015. **30**(9): p. 527-532.
46. Fritsch, MA and PS Shelton, *Geriatric Polypharmacy: Pharmacist as Key Facilitator in Assessing for Falls Risk: 2019 Update.* Clin Geriatr Med, 2019. **35**(2): p. 185-204.
47. Muraywid, B, LE Butkievich, and B Myers, *Effect of a Virtual Pharmacy Review Program: A Population Health Case Study.* J Manag Care Spec Pharm, 2020. **26**(1): p. 24-29.
48. Howell, CK, et al., *Know your medicine: A novel student-led community service learning program.* Curr Pharm Teach Learn, 2017. **9**(3): p. 353-359.
49. Lewis, NJ, et al., *The Medication Assessment Program: comprehensive medication assessments for persons taking multiple medications for chronic diseases.* J Am Pharm Assoc (2003), 2008. **48**(2): p. 171-80.
50. McNicholl, IR, et al., *A Pharmacist-Led Program to Evaluate and Reduce Polypharmacy and Potentially Inappropriate Prescribing in Older HIV-Positive Patients.* Pharmacotherapy, 2017. **37**(12): p. 1498-1506.
51. Schrader, SL, et al., *The Medication Reduction Project: combating polypharmacy in South Dakota elders through community-based interventions.* S D J Med, 1996. **49**(12): p. 441-8.
52. Willis, JS, RH Hoy, and WD Jenkins, *In-home medication reviews: a novel approach to improving patient care through coordination of care.* J Community Health, 2011. **36**(6): p. 1027-31.
53. Ulin PR, Robinson ET, Tolley EE, *Qualitative Methods in Public Health: A Field Guide for Applied Research*. 2005, San Francisco, CA: Jossey-Bass. 344.
54. Tecklenborg, S, et al., *Interventions to Reduce Adverse Drug Event-Related Outcomes in Older Adults: A Systematic Review and Meta-analysis.* Drugs Aging, 2020. **37**(2): p. 91-98.